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LABORATORY TESTS OF SOME ORGANIC COMPOUNDS AS INSECTICIDES

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A total of 237 organic compounds has been received from the Chemical-Biological Coordination Center, of the National Research Council, and tested as insecticides at the Anaheim, Calif., laboratory of this Bureau. In this report are included the results obtained from tests made from November 1949 through December 1952.

The compounds were all given initial tests as 10-percent dusts or 5-percent acetone sprays against at least three species of insects. Spider mites were sprayed at either 1- or 5-percent concentrations. Whenever time permitted, materials that had given mortalities of 10 percent in the initial test were retested at reduced concentrations.

The following species were used:

Armyworm (Pseudaletia unipuncta (Haw.))  
Celery leaf tier (Phlyctaenia rubigalis (Guen.))  
Citrus red mite (Metatetranychus citri (McG.))  
Large milkweed bug (Oncopeltus fasciatus (Dall.))  
Pea aphid (Macrosiphum pisi (Harris))  
Two-spotted spider mite (Tetranychus bimaculatus Harvey)

All species of insects were reared in the laboratory; the citrus and two-spotted mites were collected in the field. Larvae of the lepidopterous insects were placed in petri dishes with foliage that had been dusted or sprayed with the compounds. Aphids were dusted or sprayed either on or removed from the plant, and were confined during the test period on potted Windsor bean plants in cloth-capped glass battery jars 7 inches in diameter. The two-spotted spider mites were always dusted while on castor bean leaves and were then kept in battery jars.

Both active and egg stages of the citrus red mite were treated by dipping infested oranges into the insecticide. Milkweed bugs were dusted or sprayed while confined in 9-cm. crystallizing dishes in which they were retained during the test period.

In the tests with lepidopterous insects 30 larvae were used per test; a minimum of 20 milkweed bugs were used, and the number of aphids and mites ranged from around this minimum to several times this number. The test period was usually 1 day for aphids, 2 days for other insects, and 2 or 3 days for the mites.

Compounds that were tested as dusts were diluted with pyrophyllite, and generally were in good physical condition for dusting.

For comparative purposes tests were made with Aramite, lindane, DDT, and parathion. The results of the dust tests with three of these standards are shown in table 1. Results of the spray tests with all four standards are shown in table 3.

Data on 15 organic compounds that caused more than 74 percent mortality to one or more species of insects in dust tests are shown in table 2. Of these compounds 4 were effective against the armyworm, 2 against the pea aphid, and 10 against the two-spotted spider mite. None of these compounds was effective against more than one species and the only compounds that continued to cause high kills at reduced concentrations were 1-(1,3,3,3-tetrachloropropyl)cyclohexene and 3-vinylpyridine.

Data on 75 compounds that caused more than 74 percent mortality to one or more species of insects in acetone spray tests are shown in table 4. Of these compounds 24 were effective against the armyworm, 11 against the large milkweed bug, 32 against the pea aphid, 62 against the citrus red mite, and 5 against the two-spotted spider mite. Only 7 of the compounds shown in this table were tested against the two-spotted spider mite. 1-(2-chloroethyl)-2-(p-chlorophenoxy)ethane and trichloromethane phosphonic acid diethyl ester were effective against all 4 species when used at concentrations of 5 percent. However, when the concentration of the latter compound was reduced to 1 percent in tests against the armyworm and the pea aphid, low mortalities resulted. Phosphorous acid diethyl p-nitrophenyl ester was the most effective material tested. It caused high mortalities of armyworms and pea aphids when used at concentrations of 0.005 percent. Ethyl chlorophosphate was effective against the citrus mite when used at a concentration of 0.001 percent. Compared with citrus mite mortalities resulting from the use of the standard materials, ethyl chlorophosphate was roughly 20 times as effective as Aramite and 2.5 times as effective as parathion.

The 147 compounds that caused less than 75 percent mortality of the species tested are listed in table 5. Only 17 of them caused more than 50-percent mortality to one or more of the insects tested. These compounds were aniline complex with  $\frac{1}{2}$  f.wt. fluosilicic acid, benzenesulfonic acid butyl ester; 2,3-dihydro-2-methylbenzofuran; cyclohexylamine complex with  $\frac{1}{2}$  f.wt. fluosilicic acid; and 2-methoxyethanol, which were effective against the pea aphid; cis (and trans)-1,2-dichloro-1-(1,2-dichloroethyl)-cyclohexane, which was effective against the pea aphid and the armyworm, and 2 {2-[2-(3-aminopropoxy)ethoxy]ethoxy} ethanol, which was effective against the pea aphid and the citrus mite; 3,4-methylenedioxy-chalcone, which was effective against the armyworm;  $\alpha$ -hydroxy- $\alpha$ -methyl-butyric acid; carbonic acid, dibenzyl ester; 2-(2-methoxyethoxy)ethanol; 2-methoxymethyl-5-nitrofuran; methylenemalonic acid, diethyl ester; 1-(p-cyclohexylphenoxy)-2-propanol; 4,4'-ethylenedipyridine; salicylic acid, ethyl ester, diester with carbonic acid; and N-(methoxymethyl)stearamide, which were effective against the citrus mite.

Table 1.--Effectiveness of three insecticides tested against various species of insects fed dusted foliage, to be used as standards for comparing results obtained with new compounds as insecticides

Compound	Percent	Insect	Stage	Amount used in vacuum duster	Average deposit per square centimeter	Average kill		
						after-		
						1 day	2 days	3 days
<u>Grams</u>						<u>Percent</u>		
<u>Micrograms</u>						<u>Percent</u>		
DDT	0.5	Armyworm	Third instar	1	-	-	88	-
		do.	do.	-	200	-	79	-
	.5	Celery leaf tier	Third instar	-	280	-	-	96
		do.	do.	-	245	-	72	-
Lindane	.25	Armyworm	Third instar	1	-	-	50	-
	.125	Large milkweed bug	Fourth instar	-	132	-	84	-
	.125	Pea aphid	Second instar	-	84	64	-	-
Parathion	.01	Pea aphid	Adult	1	-	73	-	-
	.005	do.	Second instar	1	-	94	-	-
	.05	Two-spotted spider mite	Nymphs and adults	-	212	-	-	95
		do.	do.	-	300	-	74	-
		do.	do.	1	-	-	-	99



Table 2.--Compounds causing greater than 74 percent mortality of one or more species of insect when used as dusts

Compound	Percent	Insect	Stage	Amount used in vacuum duster	Average deposit per square centimeter	Average kill after-		
						1 day	2 days	3 days
				Grams	Micrograms	Percent	Percent	Percent
Benzenesulfon- amide, N-butyl-	10	Armyworm	Third instar	1	-	-	0	-
		Large milkweed bug	Fourth instar	-	230	-	15	-
		Pea aphid	Second instar	-	200	0	-	-
		Two-spotted spider mite	Nymphs and adults	-	250	-	-	85
	5	do.	Adults	-	245	-	0	-
Benzenesul- fonamide, N, N-dibutyl-	10	Armyworm	Third instar	1	-	-	0	-
		Large milkweed bug	Fourth instar	-	250	-	10	-
		Pea aphid	Second instar	-	200	0	-	-
		Two-spotted spider mite	Nymphs and adults	-	230	-	-	100
	5	do.	Adults	-	255	-	12	-
Benzenesul- fonamide, N, N-diethyl-	10	Armyworm	Third instar	1	-	-	0	-
		Large milkweed bug	Fourth instar	-	215	-	5	-
		Pea aphid	Second instar	-	310	8	-	-
		Two-spotted spider mite	Nymphs and adults	-	265	-	-	100
	5	do.	Adults	-	255	-	39	-
Benzenesul- fonamide, N-ethyl-	10	Armyworm	Third instar	1	-	-	13	-
		Large milkweed bug	Fourth instar	-	215	-	15	-
		Pea aphid	Second instar	-	215	0	-	-
		Two-spotted spider mite	Nymphs and adults	-	250	-	100	-
	5	do.	Adults	-	260	-	0	-

Benzenesul- fonamide, N- isopropyl-	10	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite do.	Third instar Fourth instar Second instar Nymphs and adults Adults	1 - - - - -	- 200 230 265 295	- - 0 - - -	42 0 - 90 39	- - - - -
Benzenethiol, p-chloro-	10	Celery leaf tier Large milkweed bug Pea aphid Two-spotted spider mite do. do.	Third instar Fourth instar Two-day-old nymphs Nymphs and adults Adults do.	- - - - - 1 -	250 230 280 315 - 205	- - 0 - - -	25 0 - - - 16	- - - 94 96 -
Carbonic acid, bis(x-methyl- benzyl) ester	10	Celery leaf tier Large milkweed bug Pea aphid Two-spotted spider mite do. do.	Third instar Fourth instar Second instar Nymphs and adults Adults do.	- - - - - 1 -	250 230 215 215 - 290	- - 0 - - -	8 0 - - - 0	- - - 89 49 -
Cyclohexane, 1- chloro-3(and 4)- (1,2-dichloro- ethyl)-	10	Armyworm Large milkweed bug Pea aphid do. Two-spotted spider mite	Third instar Fourth instar Second instar Adult Nymphs and adults	- - 1 1 -	250 240 - - 215	- - 93 0 -	63 0 - - 0	- - - - -
Cyclohexene, 4- (1,3,3,3-tetra- chloropropyl)-	10	Armyworm do. do. do.	Third instar do. do. do.	- 1 1 1	260 - - -	- - - -	100 100 100 27	- - - -

Table 2.--(Continued)

Compound	Insect	Stage	Amount used in vacuum duster	Average deposit		Average kill	
				per square centimeter	1 day	2 days	3 days
Grams							
Percent				Micrograms	Percent	Percent	
Cyclohexene, 4- 2,3,3,3- tetrafluoro- propyl- (continued)	10 Large milkweed bug	Fourth instar	-	240	-	-	
	5 Pea aphid	Second instar	1	-	100	-	
	10 do.	Adults	1	-	0	-	
	10 Two-spotted spider mite	Nymphs and adults	-	295	-	16	
Methylcyclohexyl- acetate, 2-allyl- ethoxy-	10 Armyworm	Third instar	1	-	-	100	
	5 do.	do.	1	-	-	0	
	10 Large milkweed bug	Fourth instar	1	-	-	0	
	Pea aphid	Adults	1	-	7	-	
Phenol, 2-allyl- ethoxy-	10 Two-spotted spider mite	do.	-	260	-	0	
	Colony leaf tier	Third instar	-	280	-	0	
	Large milkweed bug	Fourth instar	-	230	-	0	
	Pea aphid	Second instar	-	215	31	-	
Pyridine, 2- pyrrolidin- yl-	5 Two-spotted spider mite	Nymphs and adults	-	265	-	93	
	do.	Adults	-	235	-	0	
	10 Armyworm	Third instar	1	-	-	83	
	5 do.	do.	1	-	-	33	
Pyridine, 2- pyrrolidin- yl-	10 Large milkweed bug	Fourth instar	1	-	-	0	
	Pea aphid	Adults	1	-	0	-	
	Two-spotted spider mite	do.	-	230	-	0	

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Pyridine, 3-vinyl-	10	Armyworm	Third instar	1	-	-	100	-
	5	do.	do.	1	-	-	77	-
	10	Large milkweed bug	Fourth instar	1	-	-	5	-
		Pea aphid	Adults	1	-	0	-	-
		Two-spotted spider mite	do.	-	270	-	0	-
Terephthalic acid, 10 dibutyl ester		Celery leaf tier	Third instar	-	265	-	0	-
		Large milkweed bug	Fourth instar	-	230	-	10	-
		Pea aphid	Second instar	-	215	25	-	-
		Two-spotted spider mite	Nymphs and adults	-	250	-	-	100
	5	do.	Adults	1	-	-	-	69
		do.	do.	-	260	-	0	-

Table 3.--Effectiveness of four insecticides tested against various species of insects fed sprayed foliage, to be used as standards for comparing results with new compounds as insecticides

Compound	Concentration in acetone	Insect	Stage	Average kill after--	
				2 days	3 days
				<u>Percent</u>	
Aramite	0.02	Citrus mite	Adult	-	93
	.01	Two-spotted spider mite	Adult	75	-
				98	-
DDT	.05	Armyworm	Third instar	71	-
	.005	Large milkweed bug	Fourth instar	75	-
Lindane	.0025	Citrus mite	Adult	64	-
	.005	Pea aphid	do.	93	-



Table 4.--Compounds causing more than 74 percent mortality of one or more species of insects when used as acetone sprays

Compound	Concentration in acetone	Insect	Stage	Average kill after--	
				2 days	3 days
	Percent			Percent	Percent
Diamyl phosphite	5	Amyworm	Third instar	0	-
	5	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	100	-
	1	do.	do.	0	-
Benzenephosphonic acid	5	Amyworm	Third instar	0	-
	5	Citrus mite	Adult	100	-
	1	do.	do.	70	-
	5	Large milkweed bug	Fourth instar	5	-
	5	Pea aphid	Adult	0	-
Benzoic acid, o-chloro-, 2-chloroethyl ester	5	Amyworm	Third instar	100	-
	1	do.	do.	100	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	5	-
	5	Pea aphid	Adult	0	-
Benzoic acid, p-chloro-, 2-chloroethyl ester	5	Amyworm	Third instar	100	-
	1	do.	do.	0	-
	1	Citrus mite	Adult	-	100
	5	Large milkweed bug	Fourth instar	40	-
	5	Pea aphid	Adult	0	-
Benzoic acid, o-chloro-, 2,2-dichloroethyl ester	1	Amyworm	Third instar	0	-
	1	Citrus mite	Adult	96	-
	5	Large milkweed bug	Fourth instar	5	-
	5	Pea aphid	Adult	0	-

Table 4.--(Continued)

Compound	Concentration in acetone	Insect	Stage	Average kill after--	
				2 days	3 days
Percent					
Percent					
Benzoic acid, p-chloro-, 2,2-dichloroethyl ester	5	Armyworm	Third instar	100	-
	1	do.	do.	7	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	0	-
Benzoic acid, p-chloro-, 2,2,2-trichloroethyl ester	5	Armyworm	Third instar	100	-
	1	do.	do.	7	-
	1	Citrus mite	Adult	-	94
	5	Large milkweed bug	Fourth instar	25	-
	5	Pea aphid	Adult	14	-
Benzoic acid, 3,4- dichloro-, 2-chloro- ethyl ester	5	Armyworm	Third instar	100	-
	1	do.	do.	0	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	0	-
Benzoic acid, 2,4- dichloro-, 2,2- dichloroethyl ester	5	Armyworm	Third instar	83	-
	1	do.	do.	0	-
	1	Citrus mite	Adult	-	100
	5	Large milkweed bug	Fourth instar	15	-
	5	Pea aphid	Adult	69	-
Benzoic acid, 3,4- dichloro-, 2,2-dichloro- ethyl ester	5	Armyworm	Third instar	100	-
	1	do.	do.	0	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	0	-

Benzoic acid, 3,4-di-chloro-, 2,2,2-tri-chloroethyl ester	1 1 5 5	Armyworm Citrus mite Large milkweed bug Pea aphid	Third instar Adult Fourth instar Adult	73 - 0 67	- 100 - -
Benzyl alcohol, <i>d</i> , <i>d</i> -dimethyl-	5 1 1 5 5	Armyworm do. Citrus mite Large milkweed bug Pea aphid	Third instar do. Adult Fourth instar Adult	93 0 0 20 -	- - - - 0
Butanediphosphonic acid, tetraethyl ester	5 5 5 5	Armyworm Citrus mite Large milkweed bug Pea aphid	Third instar Adult Fourth instar Adult	0 - 0 0	- 100 - -
1-Butanephosphonic acid, diethyl ester	5 5 5 5	Armyworm Citrus mite Large milkweed bug Pea aphid	Third instar Adult Fourth instar Adult	0 100 50 52	- - - -
Dibutyl phosphate, diester with ethylene glycol	5 1 5 5	Armyworm Citrus mite Large milkweed bug Pea aphid	Third instar Adult Fourth instar Adult	0 100 5 83	- - - -
Dibutyl phosphate, diester with 1,3-propanediol	5 1 5 5	Armyworm Citrus mite Large milkweed bug Pea aphid	Third instar Adult Fourth instar Adult	0 100 55 73	- - - -
Tributyl phosphite	5 1 5 5 1	Armyworm Citrus mite Large milkweed bug Pea aphid do.	Third instar Adult Fourth instar Adult do.	23 100 15 100 38	- - - - -

Table 4.--(Continued)

Compound	Concentration in acetone	Insect	Stage	Average kill after~	
				2 days	3 days
<u>Percent</u>					
Cyclohexanecetic acid, $\alpha$ -butyl-	5	Armyworm	Third instar	100	-
	1	do.	do.	20	-
	1	Citrus mite	Adult	-	87
	5	Large milkweed bug	Fourth instar	10	-
	5	Pea aphid	Adult	-	92
Ethane, 1-(2-chloro- ethoxy)-2-( <u>o</u> -chloro- phenoxy)-	5	Armyworm	Third instar	100	-
	1	do.	do.	47	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	65	-
	5	Pea aphid	Adult	84	-
Ethane, 1-(2-chloro- ethoxy)-2-( <u>p</u> -chloro- phenoxy)-	5	Armyworm	Third instar	100	-
	1	do.	do.	100	-
	1	Citrus mite	Adult	-	100
	5	Large milkweed bug	Fourth instar	100	-
	5	Pea aphid	Adult	41	-
Ethane, 1-(2-chloro- ethoxy)-2-(2,3,4,6- tetrachlorophenoxy)-	5	Armyworm	Third instar	100	-
	1	do.	do.	90	-
	1	Citrus mite	Adult	-	100
	5	Large milkweed bug	Fourth instar	15	-
	5	Pea aphid	Adult	30	-
1,2-Ethanediphosphonic acid, tetrabutyl ester	5	Armyworm	Third instar	47	-
	5	Citrus mite	Adult	-	100
	5	Large milkweed bug	Fourth instar	15	-
	5	Pea aphid	Adult	73	-



1,2, Ethanedi-phosphonic acid, tetrakis(2-ethyl- hexyl) ester	5 1 5 5	Armyworm Citrus mite Large milkweed bug Pea aphid	Third instar Adult Fourth instar Adult	0 100 0 83	- - - -
Ethanephosphonic acid, diethyl ester	5 5 5 1 5	Armyworm Citrus mite Large milkweed bug do. Pea aphid	Third instar Adult Fourth instar do. Adult	0 72 90 10 30	- - - - -
Ethanephosphonic acid, 1-oxo-, diethyl ester	5 5 5 5 1	Armyworm Citrus mite Large milkweed bug Pea aphid do.	Third instar Adult Fourth instar Adult do.	0 100 20 96 45	- - - - -
Ethanephosphonic acid, öctyl ester	5 5 5 5 1	Armyworm Citrus mite Large milkweed bug Pea aphid do.	Third instar Adult Fourth instar Adult do.	0 100 0 100 40	- - - - -
Ethanol, 2-butoxy-	5 5 5 5	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite	Third instar Fourth instar Adult Adult	0 0 87 18	- - - -
Ethanol, 2-(2-butoxy- ethoxy)-	5 5 5 1 5	Armyworm Large milkweed bug Pea aphid do. Two-spotted spider mite	Third instar Fourth instar Adult do. Adult	0 20 95 69 60	- - - - -

Table 4.--(Continued)

Compound	Concentration in acetone	Insect	Stage	Average kill after-	
				2 days	3 days
Percent					
Ethanol, 2-[2-tert-butylphenoxy]-	5	Armyworm	Third instar	13	-
	5	Large milkweed bug	Fourth instar	70	-
	5	Pea aphid	Adult	85	-
	5	Two-spotted spider mite	do.	100	-
	1	do.	do.	88	-
Ethanol, 2-[2-(2-chloroethoxy)ethoxy]-	5	Armyworm	Third instar	0	-
	5	Large milkweed bug	Fourth instar	5	-
	5	Pea aphid	Adult	67	-
	5	Two-spotted spider mite	do.	81	-
	5	do.	do.	0	-
Ethanol, 2-(p-nonylphenoxy)-(mixture of nonyl isomers)	5	Armyworm	Third instar	0	-
	.5	Citrus mite	Adult	100	-
	.1	do.	do.	55	-
	5	Large milkweed bug	Fourth instar	5	-
	5	Pea aphid	Adult	87	-
Ethanol, 1,1'-oxybis-[2-chloro-	5	Two-spotted spider mite	do.	100	-
	1	do.	do.	100	-
	0.5	Armyworm	Third instar	67	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	0	-
Diethyl chlorophosphate	5	Pea aphid	Adult	10	-
	.1	Armyworm	Third instar	0	-
	.05	Citrus mite	Adult	100	-
	.01	do.	do.	100	-
	.005	do.	do.	-	98
.001	do.	do.	-	92	
				91	-

	.5	Large milkweed bug	Fourth instar	-	100
	.1	do.	do.	85	-
	.05	do.	do.	0	-
	.1	Pea aphid	Adult	100	-
	.05	do.	do.	100	-
	.01	do.	do.	60	-
	.01	do.	do.	51	-
	5	Armyworm	Third instar	0	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	5	-
	5	Pea aphid	Adult	30	-
	5	Armyworm	Third instar	100	-
Ethyl thiophosphate	1	do.	do.	33	-
	5	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	38	-
	5	Armyworm	Third instar	83	-
	1	Citrus mite	Adult	0	-
2-Furancrylic acid, trans-	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	-	21
	5	Armyworm	Third instar	0	-
	1	Citrus mite	Adult	96	-
Formic acid, phosphono-, triethyl ester	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	58	-
	5	Armyworm	Third instar	3	-
	1	Citrus mite	Adult	-	100
1-Heptanephosphonic acid, diethyl ester	5	Large milkweed bug	Fourth instar	45	-
	5	Pea aphid	Adult	100	-
	5	Armyworm	Third instar	3	-
	1	Citrus mite	Adult	-	100

Table 4.--(Continued)

Compound	Concentration in acetone	Insect	Stage	Average kill after-	
				2 days	3 days
<u>Percent</u>					
4-Heptanone, 2,3,6-trimethyl-	5	Armyworm	Third instar	0	-
	1	Citrus mite	Adult	-	86
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	-	24
Diheptyl phosphite	5	Armyworm	Third instar	7	-
	5	Citrus mite	Adult	-	100
	5	Large milkweed bug	Fourth instar	5	-
	5	Pea aphid	Adult	45	-
1-Hexanephosphonic acid, diethyl ester	5	Armyworm	Third instar	0	-
	5	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	40	-
	5	Pea aphid	Adult	75	-
1,6-Hexanediphosphonic acid, tetraethyl ester	5	Armyworm	Third instar	0	-
	5	Citrus mite	Adult	-	100
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	9	-
1,6-Hexanediphosphonic acid, tetrakis(2-ethylhexyl) ester	5	Armyworm	Third instar	0	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	13	-
4-Hexen-3-ol	5	Armyworm	Third instar	93	-
	1	do.	do.	0	-
	1	Citrus mite	Adult	9	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	-	0



Methanephosphonic acid, trichloro-, diethyl ester	5	Amyworm	Third instar	100	-
	1	do.	do.	40	-
	5	Citrus mite	Adult	93	-
	5	Large milkweed bug	Fourth instar	100	-
	1	do.	do.	10	-
4, 7-Methanoinden-5-ol, octahydro-	5	Pea aphid	Adult	91	-
	1	do.	do.	24	-
	5	Amyworm	Third instar	93	-
	5	do.	do.	70	-
	5	Large milkweed bug	Fourth instar	45	-
1-Octanephosphonic acid, diethyl ester	5	Pea aphid	Adult	0	-
	5	Two-spotted spider mite	do.	100	-
	1	do.	do.	30	-
	5	Amyworm	Third instar	20	-
	5	Citrus mite	Adult	-	100
Octyl chlorophosphite	5	Large milkweed bug	Fourth instar	35	-
	5	Pea aphid	Adult	100	-
	5	Amyworm	Third instar	0	-
	1	Citrus mite	Adult	91	-
	5	Pea aphid	do.	100	-
Diocetyl chlorophosphite	1	do.	do.	9	-
	5	Amyworm	Third instar	27	-
	5	Citrus mite	Adult	-	100
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	58	-
1-Pentanephosphonic acid, diethyl ester	5	Amyworm	Third instar	13	-
	5	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	80	-
	5	Pea aphid	Adult	100	-
	1	do.	do.	80	-

Table 4.--(Continued)

Compound	Concentration in acetone	Insect	Stage	Average kill after	
				2 days	3 days
				Percent	Percent
Phenol, <u>p</u> -sec-tubyl-	5	Armyworm	Third instar	100	-
	1	do.	do.	80	-
	1	Citrus mite	Adult	-	93
	5	Large milkweed bug	Fourth instar	100	-
	5	Pea aphid	Adult	-	100
Phenol, 2,4-dichloro- 5-phenyl-	5	Armyworm	Third instar	100	-
	1	do.	do.	0	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	90	-
	5	Pea aphid	Adult	79	-
Phenol, <u>o</u> -isopropyl-	5	Armyworm	Third instar	100	-
	1	do.	do.	13	-
	5	Large milkweed bug	Fourth instar	15	-
	5	Pea aphid	Adult	100	-
	1	do.	do.	26	-
Phenol, <u>m</u> -isopropyl-	5	Two-spotted spider mite	do.	95	-
	1	do.	do.	52	-
	5	Armyworm	Third instar	100	-
	1	do.	do.	87	-
	1	Citrus mite	Adult	-	48
Phenol, 4,4'-isopropyl- idenebis[2-isopropyl -	5	Large milkweed bug	Fourth instar	75	-
	5	Pea aphid	Adult	-	96
	5	Armyworm	Third instar	100	-
	1	do.	do.	87	-
	1	Citrus mite	Adult	-	48
Phenol, 4,4'-isopropyl- idenebis[2-isopropyl -	5	Large milkweed bug	Fourth instar	75	-
	5	Pea aphid	Adult	-	96
	5	Armyworm	Third instar	100	-
	1	do.	do.	87	-
	1	Citrus mite	Adult	-	48

Phosphoric acid, bis(2-ethylhexyl) ester, diester with 1,3-propanediol	5	Armyworm	Third instar	0	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	60	-
Phosphoric acid, bis(3,5,5-trimethylhexyl) ester, diester with 1,3-propanediol	5	Armyworm	Third instar	0	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	37	-
Phosphoric acid, diethyl 2-(2,4,5-trichlorophenoxy)-, ethyl ester	5	Armyworm	Third instar	57	-
	5	Citrus mite	Adult	-	100
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	93	-
Phosphoric acid, trioctyl ester(mix. of isomers)	5	Armyworm	Third instar	0	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	62	-
Phosphorous acid, bis-(2-ethylhexyl) ester	5	Armyworm	Third instar	33	-
	5	Citrus mite	Adult	-	100
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	24	-
Phosphorous acid, bis-(1-methylheptyl), ester	5	Armyworm	Third instar	40	-
	5	Citrus mite	Adult	-	100
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	67	-
Phosphorous acid, bis-(3,5,5-trimethylhexyl) ester	5	Armyworm	Third instar	17	-
	5	Citrus mite	Adult	-	100
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	0	-

Table 4.--(Continued)

Compound	Concentration in acetone	Insect	Stage	Average kill after-	
				2 days	3 days
Percent				Percent	Percent
Phosphorous acid, diethyl p-nitrophenyl ester	0.025	Armyworm	Third instar	100	-
	.01	do.	do.	97	-
	.005	do.	do.	97	-
	.0025	do.	do.	60	-
	.05	Citrus mite	Adult	100	-
	.05	Large milkweed bug	Fourth instar	100	-
	.01	do.	do.	20	-
	.05	Pea aphid	Adult	100	-
	.01	do.	do.	96	-
	.005	do.	do.	89	-
	.1	Two-spotted spider mite	do.	-	100
	.01	do.	do.	-	95
.005	do.	do.	-	83	
.05	do.	Eggs	19 (4 days)		
Phosphorous acid, methyl octyl ester	5	Armyworm	Third instar	47	-
	5	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	100	-
	1	do.	do.	17	-
Phosphorous acid, tris- (2-ethylhexyl) ester	5	Armyworm	Third instar	27	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	51	-
1,3-Propanediphosphonic acid, tetrabutyl ester	5	Armyworm	Third instar	0	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	50	-
	5	Pea aphid	Adult	94	-



1,3-Propanediphosphonic acid, tetraethyl ester	5	Armyworm	Third instar	0	-
	5	Citrus mite	Adult	-	100
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	0	-
1,3-Propanediphosphonic acid, tetra-kis(2-ethylbutyl) ester	5	Armyworm	Third instar	0	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	95	-
1,3-Propanediphosphonic acid, tetra-kis(2-ethylhexyl), ester	5	Armyworm	Third instar	0	-
	1	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	88	-
2-Propanol, 1-cyclohexyloxy-	5	Armyworm	Third instar	100	-
	1	do.	do.	76	-
	1	Citrus mite	Adult	-	25
	5	Large milkweed bug	Fourth instar	35	-
	5	Pea aphid	Adult	-	0
2-Propanol, 1,1'-isopropylidenebis(p-phenyleneoxy)di-	5	Armyworm	Third instar	0	-
	5	Citrus mite	Adult	83	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	0	-
Propionic acid, $\alpha$ -chloro-, methyl ester	5	Armyworm	Third instar	100	-
	1	do.	do.	0	-
	1	Citrus mite	Adult	78	-
	5	Large milkweed bug	Fourth instar	5	-
	5	Pea aphid	Adult	0	-

Table 4.--(Continued)

Compound	Concentration in acetone	Insect	Stage	Average kill after -	
				2 days	5 days
				Percent	
<u>Percent</u>					
Propionic acid, $\beta$ -chloro-, methyl ester	5	Armyworm	Third instar	0	-
	1	Citrus mite	Adult	80	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	0	-
Dipropyl phosphite	5	Armyworm	Third instar	3	-
	5	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	5	-
	5	Pea aphid	Adult	51	-
Tripropyl phosphite	5	Armyworm	Third instar	0	-
	5	Citrus mite	Adult	100	-
	5	Large milkweed bug	Fourth instar	0	-
	5	Pea aphid	Adult	90	-
	1	do.	do.	14	-

Table 5.--Compounds causing less than 75 percent mortality of any species of insect fed dusted or sprayed foliage. Ten percent dusts, 5 percent acetone sprays, unless indicated otherwise.

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5-Acenaphthenecrotonic acid, $\alpha$ -oxo-	Cornstarch, tri- <u>o</u> -chlorophenyl-
Acetic acid, trifluoro-	carbamate, polymer
<u>dl</u> -Alanine, N-(2-cyanoethyl)-	Coumarin, 3-acetyl-8-methoxy-
<u>dl</u> -Alanine, N,N-bis(2-cyanoethyl)-	<u>o</u> -Cresol, 6-allyl-
Allyl sulfate, mono-, sodium salt	Cyclohexane, <u>cis</u> (and <u>trans</u> )-1,2-
Ammonium chloride, ( <u>x</u> -kerylbenzyl)-	dichloro-4-(1,2-dichloroethyl)-
trimethyl-	1,4-Cyclohexanediol
Aniline, complex with $\frac{1}{2}$ f.wt. fluo-	Cyclohexane, 1,2,4,5-tetramethyl <u>1</u> /
silicic acid	Cyclohexane, 1,2,4-trimethyl- <u>1</u> /
<u>dl</u> -Aspartic acid, N-(2-cyanoethyl)-	Cyclohexylamine, complex with
<u>dl</u> -Aspartic acid, N,N-bis(2,cyanoethyl)-	$\frac{1}{2}$ f.wt. fluosilicic acid
<u>p</u> -Benzenediacetic acid, 2,5-dihydroxy-	Diamidophosphoryl chloride,
Benzenesulfonic acid, butyl ester	tetramethyl <u>1</u> /
Benzenesulfonic acid, <u>x</u> - <u>sec</u> -butyl-,	1,2-Ethanediphosphonic acid
phenyl ester	1,2-Ethanediphosphonic acid,
Benzenesulfonic acid, diester with	tetraethyl ester
diethylene glycol	Ethanol, 2-{2-[2-(3-aminopropoxy)-
Benzenesulfonic acid, ethyl ester	ethoxy]ethoxy} -
Benzenesulfonic acid, ethylene diester	Ethanol, 2-(2-chloroethoxy)-
Benzenesulfonic acid, propyl ester	Ethanol, 2-(2-dimethylamino-
Benzofuran, 2,3-dihydro-2-methyl- <u>1</u> /	ethoxy)- <u>1</u> /
Benzofuran, 3,6-dimethyl-	Ethanol, 2-(2-ethoxyethoxy)-
Benzonitrile	Ethanol, 2,2'-iminodi, complex
9,9'-Bianthryl	with $\frac{1}{2}$ f.wt. fluosilicic acid
Butyric acid, allyl ester <u>1</u> /	Ethanol, 2-isopropoxy-
Butyric acid, 1-(2-benzyloxy-	Ethanol, 2-(2-isopropoxyethoxy)-
carbethoxy)ethyl ester	Ethanol, 2-methoxy-
Butyric acid, $\alpha$ -hydroxy- $\alpha$ -methyl- <u>1</u> /	Ethanol, 2-(2-methoxyethoxy)-
Carbonic acid, bis( <u>o</u> -chlorobenzyl) ester	Ethanol, 2,2',2"-nitrilotri-,
Carbonic acid, dibenzyl ester	complex with $\frac{1}{2}$ f.wt. fluo-
Carbonic acid, bis(2,4-dichloro-	silicic acid
benzyl) ester	Ethyl chlorothiophosphate <u>1</u> /
Carbonic acid, bis(2,4-dimethyl-	Furan, 2-methoxymethyl-5-nitro-
benzyl) ester	Furan, 2-[2-(2,4,6-trinitro-
Carbonic acid, bis( <u>x</u> -isopropyl-	phenyl)-vinyl]-
benzyl) ester	<u>d</u> -Glucoside, <u>d</u> -allyl-
Carbonic acid, bis[tri(and tetra)	<u>l</u> -Glutamic acid, N,N-bis(2-
methylbenzyl) ester	cyanoethyl)-, monohydrate
Chalcone, 3,4-methylenedioxy-	<u>l</u> -Glutamic acid, N-( <u>p</u> -nitro-
$\alpha$ -Conidendrin	phenylsulfonyl)-
$\beta$ -Conidendrin	<u>l</u> -Glutamic acid, N-(sulfanilyl)-
$\beta$ -Conidendrol	Glycocyamine
$\alpha$ -Conidendrol, dihydrate	Guaiacol, 6-allyl-

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1/ One-percent acetone spray used against citrus mite.

Table 5.--(Continued)

Guanidine, complex with $\frac{1}{2}$ f.wt. fluosilicic acid	Nicotinic acid, hexyl ester
Indan, x,x-dichloro-1,1,3-trimethyl-3-phenyl-	Nicotinic acid, octyl ester
Indole, 2-(p-chlorophenyl)-	Oxamide
Iodonium chloride, bis(p-chlorophenyl)-	Pelargonic acid, ester with allyl lactate
Iodonium chloride, bis(p-iodophenyl)-	2-Pentanone
Iodonium chloride, diphenyl-	Phenol, o-allyl-
Iodonium iodide, bis(p-chlorophenyl)-	Phthalic acid, diester with 2-ethylbutyl lactate
Iodonium iodide, bis(p-iodophenyl)-	Piperidine, 4,4'-ethylenedi-
Iodonium iodide, diphenyl-	2-Propanol, 1-butoxy-
Iodonium sulfate, bis(p-chlorophenyl)-	2-Propanol, 1-(p-cyclohexylphenoxy)-
Iodonium sulfate, bis(p-iodophenyl)-	2-Propanol, 2,2'-iminodi-, complex with $\frac{1}{2}$ f.wt. fluosilicic acid
Iodonium triiodide, diphenyl-	2-Propanol, 1-methoxy-, acetate
Lactic acid, acetate, p-tert-butylphenyl ester	Propionic acid, $\beta$ -decyloxy-, decyl ester
Lactic acid, acetate, diester with triethylene glycol	Pyridine, 2,6-distyryl-
Lactic acid, acetate, 2-(2-ethylhexyloxy)ethyl ester	Pyridine, 4,4'-ethylenedi-
Lactic acid, acetate, hexadecyl ester	Pyridine, 4,4',4"-glyceryltri-
Lactic acid, allyl ester	Pyridine, 3-(hydroxymercuri)-, stearate
Lactic acid, tetrahydrofurfuryl ester, hydrogen carbonate, diester with diethylene glycol	Pyridine, 4,4'-vinylenedi-
l-Leucine, N-(2-cyanoethyl)-	Pyrimidine, 2,4,5,6-tetramino-, monosulfite
Linoleanilide, dimer	4-Pyrimidol, 2,5,6-triamino-, monosulfate, monohydrate
Maleic acid, diester with 2-ethylbutyl lactate	l-Pyroglutamic acid, 1-(2-cyanoethyl)-
Maleic acid, diester with 2-ethylhexyl lactate	4-Quinazolinol, 2-methyl-
Malonic acid, allyl- $\frac{1}{2}$	Salicyclic acid, ethyl ester, diester with cathionic acid $\frac{1}{2}$
Malonic acid, methylene-, diethyl ester	Sesamol
Metanicotine	Stearamide, N-benzyl-
dl-Methionine, N-(2-cyanoethyl)-	Stearamide, N-(ethoxymethyl)-
Morpholine, complex with $\frac{1}{2}$ f.wt. fluosilicic acid	Stearamide, N-(hydroxymethyl)-
Naphthalene, 1,5-dimethoxy-	Stearamide, N-(isopropoxymethyl)-
Nicotinic acid, amyl ester	Stearamide, N-(methoxymethyl)-
Nicotinic acid, butyl ester	Stearamide, N,N'-methylenebis-
Nicotinic acid, cyclohexyl ester	Stearamide, N-(octyloxymethyl)-
Nicotinic acid, decyl ester	Stearamide, N,N'-m-phenylenebis-
	Stearamide, N,N'-p-phenylenebis-
	Stearamide, N,N'-2,4-tolylenebis-
	Stearamide, N,N'-2,5-tolylenebis-
	Stearamide, N,N'-3,4-tolylenebis-
	4,4'-Bi-o-stearanilide
	p-Stearotoluidide
	Sulfanilamide, N''-(2-benzimidazolylmethyl)-



Table 5.--(Continued)

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Sulfide, ethyl phenyl  
Terephthalic acid, bis(2-ethylhexyl) ester  
Thiocyanic acid, x-kerylbenzyl ester  
Toluene, Q-chloro-x-keryl-  
m-Tolunitrile  
o-Tolunitrile  
p-Tolunitrile  
l-Tyrosine, N-(2-cyanoethyl)-  
Uric acid  
Xanthic acid, sec-butyl-, sodium salt  
Xanthic acid, isopropyl-, sodium salt

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